

## PATENT COOPERATION TREATY

## PCT

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## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference ABB 55PCT	<b>FOR FURTHER ACTION</b> See Form PCT/IPEA/416	
International application No. PCT/FI2004/000289	International filing date (day/month/year) 13.05.2004	Priority date (day/month/year) 15.05.2003
International Patent Classification (IPC) or national classification and IPC H02H3/253		
Applicant ABB OY et al.		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 3 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (Indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and Industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  14.03.2005	Date of completion of this report  27.09.2005	
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Braccini, R  Telephone No. +49 89 2399-2470	



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/FI2004/000289

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1, 2, 4-9	as published
3	filed with telefax on 14.03.2005

**Claims, Numbers**

1-9	filed with telefax on 14.03.2005
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**Drawings, Sheets**

1/3-3/3	as published
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- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
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International application No.  
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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-9
	No: Claims	
Inventive step (IS)	Yes: Claims	1-9
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-9
	No: Claims	

2. Citations and explanations (Rule 70.7):

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

**1. Reference is made to the following documents:**

D1: US-A-3 999 087 (COMPTON J R) 21 Dec. 1976  
D2: US-A-4 027 204 (NORBECK D K) 31 May 1977  
D3: US-A-3 001 100 (SCHUH N F ET AL) 19 Sept. 1961

**2. The document D1 is regarded as being the closest prior art to the subject-matter of independent claim 1, and shows a phase failure detector for a multi-phase electricity supply network, according to the preamble of present claim 1.  
Particularly, D1 teaches a phase failure detector including a detector circuit (21A,21B,21C) for each phase, which detector circuit has a first connection point for connecting to the phase ( $\phi_A, \phi_B, \phi_C$ ) being monitored and a second connection point, which is connected to a common connection point (N) of the detector circuits, in which each detector circuit includes voltage divider elements (22A-22C,24A-24C,26A-26C) for dividing voltage between the first and the second connection point and for feeding reduced voltage to an input point (cathodes of 26A-26C), and a trigger and detector circuit (16A-16C) connected between the reduced voltage input point and the second connection point.**

**2.1 The subject-matter of claim 1 differs from this known phase failure detector in that**

- i) the voltage divider elements include at least two capacitive elements, which participate in the division of the voltage and of which at least one is arranged to store energy and to discharge the energy it stores through the trigger and detector circuit, and**
- ii) each trigger and detector circuit is arranged to produce a detection pulse when the reduced voltage reaches a trigger value, whereby the phase failure detector can, in addition to detecting a fault state, also detect which of the phases is defective.**

- 2.2 The subject-matter of claim 1 is therefore new (Article 33(2) PCT).
- 2.3 The problem to be solved by the present invention may be regarded as to increase the efficiency and to improve the degree of discrimination capabilities of a phase failure detector according to D1.
- 2.4 The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) since none of the documents cited in the international search report shows or even suggests the above-mentioned differentiating features i) and ii), neither alone nor in combination.
3. Claims 2 to 9 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.
4. The industrial applicability (Art. 33(4) PCT) in view of the cited documents is obviously given for the subject-matter of all claims.

**Re Item VII**

**Certain defects in the international application**

5. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

between the phase being monitored and a common connection point, so that the common connection point forms a reference level. This reference level can be floating, in which case it corresponds to a virtual star point of the power supply network. The reference level can also be connected to a real star point, a ground potential, or some other suitable potential. The detector circuit itself includes voltage-divider elements, and a trigger circuit and detector, to which the voltage being monitored is fed in a reduced form from the voltage-divider elements.

More specifically, the phase failure detector according to the invention is characterized by what is stated in the characterizing portion of Claim 1.

The device, according to the invention, utilizing a multi-phase mains power supply is, in turn characterized by what is stated in the characterizing portion of Claim 8.

Considerable advantages are gained with the aid of the invention.

With the aid of the invention, it is possible to implement a simple and inexpensive phase failure detector, which can detect not only a fault state, but also which of the phases is defective.

The invention also has numerous embodiments, by means of which significant additional advantages are gained.

In an embodiment, in which the detector circuits are connected to a common reference point with a known potential, the phase failure detector can also detect a fault state, in which all phases are defective.

The invention permits the phase failure detector to be designed with an extremely simple construction. In such a simple embodiment, only a few discrete components are required for the phase failure detector and the manufacturing costs remain very small. The phase failure detector can also be integrated on a circuit board and manufactured with a very small physical size.

## Claims:

1. A phase failure detector (1) for a multi-phase electricity supply network, which phase failure detector includes a detector circuit (3) for each phase (2), which detector circuit (3) has a first connection point (4) for connecting to the phase (2) being monitored and a second connection point (5), which is connected to a common connection point (9) of the detector circuits, in which each detector circuit (3) includes

— voltage divider elements (6) for dividing voltage between the first (4) and the second (5) connection point and for feeding reduced voltage to an input point (7), and

— a trigger and detector circuit (8) connected between the reduced voltage input point (7) and the second connection point (5),

characterized in that

— the voltage divider elements (6) include at least two capacitive elements (C1, C2), which participate in the division of the voltage and of which at least one (C2) is arranged to store energy and to discharge the energy it stores through the trigger and detector circuit (8), and

— each trigger and detector circuit (8) is arranged to produce a detection pulse when the reduced voltage reaches a trigger value, whereby the phase failure detector can, in addition to detecting a fault state, also detect which of the phases is defective.

2. A phase failure detector according to Claim 1, characterized in that the phase failure detector includes a resistive element between the capacitive elements (C1, C2) and the first connection point (4).

3. A phase failure detector according to Claim 1 or 2, characterized in that the operating energy of the trigger and detector circuit (8) is taken from the voltage divider elements (6).

4. A phase failure detector according to any of Claims 1 - 3, characterized in that the trigger and detector circuit (8) includes a triggering circuit element (V1, V2, V3), which triggers to a conducting state when the control voltage rises to a specific

triggering level: .....

5. A phase failure detector according to any of Claims 1 - 4, characterized in that the trigger and detector circuit (8) includes a rectifier (V4).

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6. A phase failure detector according to any of Claims 1 - 5, characterized in that the trigger and detector circuit (8) includes an opto-link (V5).

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7. A phase failure detector according to any of Claims 1 - 6, characterized in that it is arranged to be used in a three-phase network, in which case the phase failure detector includes exactly three detector circuits (3).

8. A device utilizing multi-phase network input, characterized in that it includes a phase failure detector (1) according to any of Claims 1 - 7.

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9. A device according to Claim 8, characterized in that it is a rectifier and that the common connection point (9) of the detector circuits of the phase failure detector (1) is connected to a reference potential taken from the direct-voltage circuit of the rectifier.